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NASA TECH BRIEF

Lyndon B. Johnson Space Center

Holographic Evaluation of Fatigue Cracks by a Compressive Stress (Hysteresis) Technique

The detection of small tightly-closed cracks in materials, by nondestructive evaluation (NDE) tests, has been conducted with X-radiography, penetrant, ultrasonic, eddy-current, acoustic-emission, and holographic techniques. Of all these techniques, holographic interferometry seems to be more sensitive than the others.

Holographic interferometry, like classical optical interferometry, compares an unknown field of optical waves with a known one. The differences are displayed as interference bands or fringes. When translated into an NDE test, the known field of optical waves is a reference hologram obtained from an unstressed specimen. The unknown field of optical waves comes from the same specimen which is subjected to stress. It is important to note that the stress applied does not involve conventional increasing loads. Instead, the specimen is loaded initially in tension, for reference, and then is unloaded to a lower stress level. During this process, the specimen is examined with the reference hologram, which forms a differential image. This image will reveal local anomalies such as cracks in the specimen by showing a nonuniformity in the interference bands.

This technique was evaluated on fatigue-cracked 2219-T87 aluminum-alloy panels. Small cracks, approximately 0.8 mm long by 0.4 mm deep, were detected when the specimen was incrementally unloaded.

Notes:

1. The holographic test method may be of interest to the transportation, heavy equipment, and construction industries, which require structural strength in their products.
2. This technique is described in the following report:
   "The Detection of Fatigue Cracks by Nondestructive Test Methods"
   Reference: NASA CR-2369 (N74-17285).

   This report may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single report price $5.00
   (or microfiche $1.45)

Patent status:

NASA has decided not to apply for a patent.

Source: S. A. Freska and
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